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THE EFFECT OF ROOTING MEDIUM TEMPERATURE AND MOISTURE ON ROOTING OF BLACK MULBERRY HARDWOOD CUTTING

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Abstract

In this study, the effect of different temperature and humidity content of rooting medium on rooting percentage of black mulberry hard wood cutting was investigated. For this purpose, different temperature and humidity contents were applied. In the result of the study, the effect of interaction of temperature x humidity and temperature on rooting ratio was not significant. On the other hand, humidity content caused significant changes on rooting percentage. The highest rooting ratio (63,11%) was observed in cutting planted in medium with 40% humidity. The lowest rooting percentages were obtained from two other media contained higher humidity compared to medium with 40% humidity. Both temperature and humidity treatment caused significant changes in root length. Among humidity treatment, 80% humidity produced the longest roots. The longest roots were obtained from 22°C of basal heating treatment. In term of the number of root per cutting, significant difference was not found among humidity treatments while temperature treatment caused significant changes. The highest root number per cutting was observed in cutting planted at 22°C.

***Key words**: mulberry, Morus nigra, hardwood cuttings.*

INTRODUCTION

Mulberries (*Morus* spp.) belonging to the *Moraceae* family are widely distributed in many parts of the world, mainly in the northwest of South America and some parts of Africa (Datta, 2002) and their fruits are used for fresh consumption and syrup production (Davis, 1972). Their cultivation in Anatolia has been known since ancient times (Özbek, 1977). Hence, Turkey has a significant genetic potential for mulberries but the number and production of mulberry fruit decreased in the last decades due to the shift away from farming, increase of cutting and lack of sufficient maintenance. The anthocyanin found in berries and red fruits have been recently reported to possess preventive and curative properties against mouth, larynx, oesophagus, stomach and colon cancer (Prior, 2003; Zarfa et al., 2007). An excess accumulation of cyanidin-3-glucoside and cyanidin-3-rutinozit are of anthocyanin found in mulberries (Chen et al., 2005) and the contents are higher than other red fruits and some berries (Özgen et al., 2009). Expanding in application area and growing interest in the nutritional value of mulberry are increasing day by day and subsequently this interest leads to an increase in demand for mulberry seedlings and resulting higher costs. Also, the demands are not fully met due to some practical difficulties experienced in the black mulberry seedlings. Therefore, in the study, the effect of different temperature and humidity content of rooting medium on rooting percentage of black mulberry hard wood cutting was investigated. For this purpose, three temperature and humidity contents were applied. This study was performed under greenhouse conditions.

MATERIALS AND METHODS

Hardwood cuttings taken from an old branch of the rest period were prepared as 15 cm and then firstly soaked 0.3% fungicide for precaution against fungal infection. Then cuttings were submerged in indole butyric acid (IBA, 5000 ppm prepared in ethanol) for 5 seconds about 1 cm below the basal part of the cuttings. After holding the cuttings for 1-2 minutes in order to evaporate the alcohol, cuttings were planted in rooting medium. The experimental design was composed of nine rooting chamber, of which temperature and humidity were separately controlled (Figure 1).

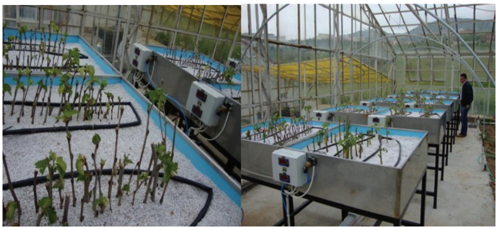

Figure1. Rooting chambers under control conditions

Temperature and humidity level for the study were determined as follows. The data, collected from Ministry of Food, Agriculture and Livestock, have been statistically processed and interpreted, building the trend line and setting up the forecast based on simulation models for the period 2012-2015. Subsequently, the rooting media were applied three different temperature degrees and humidity levels. Root zone humidity value was based on the field capacity. The desired temperature and humidity values of the table based on real-time measurements were performed with a computer-controlled system (Figure 2).

Figure 2. Computer-controlled system for temperature and humidity

The study was performed according to the complete randomized experimental design with three replicates and each replicate corresponded to 20 cuttings. The cuttings were kept in rooting media for 90 days. At the end of this period, the following measurements were made.

Callus formation: Callus was detected from cuttings and the results are expressed as a percentage of total cuttings.

Rooting rate: Adventitious root formation was detected from cuttings and the results are expressed as a percentage of total cuttings.

Root length and diameter: Adventitious root length and diameter were measured with a calliper.

Root number: Root number was expressed as the total number of adventitious formed per number of cuttings forming root.

Statistical Analysis: SPSS 17.00 statistical programme was used to determine statistical significance levels. The independent one-way ANOVA followed by Duncan multiple range test and the differences between individual averages were considered as statistically important at $p \leq 0.05$.

RESULTS AND DISCUSSIONS

Callus formation rates were collectively represented in Table 1. Whereas the highest callus formation rate (86.1 %) was obtained under 40 % field capacity and 18°C, the lowest rate was determined under 60 % field capacity and 26°C.

Concerning callus formation, no statistical significant difference was found among temperature and moisture content interaction but the effects of temperature and moisture content were significant ($p \leq 0.05$). Compared the means of temperature applications but not considering the moisture content, the highest callus formation was (71.72 %) under 22°C and the average results were statistically different and significant for each temperature application.

Table 1. Callus formation under different growth conditions

Temp.(°C)	Humidity (%)			Mean
	40	60	80	
18	86.10	60.53	55.13	67.26 AB
22	70.66	67.60	76.90	71.72 A
26	79.43	47.80	51.80	59.68 B
Mean	78.73 A	58.64 B	61.28 B	

Mean in the same column by the same letter are not significantly different to the test of Duncan ($p \leq 0.05$).

For the comparison of moisture content without evaluation of temperature, the highest value (78.73 %) was ascertained under 40 % moisture content but no statistical differences were found for 60 % (58.64 %) and 80 % (61.28 %) moisture contents (Table 1).

The highest root formation rate (69.06 %) was obtained under 40 % field capacity and 18°C, the lowest rate was determined under 80 % field capacity and 18°C. With respect to the root formation, no statistical significant difference was found among temperature and moisture content interaction but comparison of moisture content without evaluation of temperature, the highest value (63.11 %) was ascertained under 40 % moisture content but no statistical differences were found for 60 % (43.47 %) and 80 % (49.57 %) moisture contents (Table 2).

Table 2. Root formation under different growth conditions

Temp. (°C)	Humidity (%)			Mean
	40	60	80	
18	69.06	38,60	36.30	47.99
22	64.16	48,46	66,96	59.87
26	56.10	43,33	45.43	48.29
Mean	63.11 A	43.47 B	49.57 B	

Mean in the same column by the same letter are not significantly different to the test of Duncan (p≤0. 05).

Concerning with root length, no significant difference was found among temperature and moisture content interaction but the effects of temperature and moisture content were significant (p≤0.05).

Compared the means of temperature applications but not considering the moisture content, the highest root length (43.21 cm) was under 22°C but the average results were not statistically different at 18°C and 26°C.

Also, the highest root length value (42.64 cm) was obtained from 80 % but moisture content (40 % and 60 %) did not elicit statistically significant differences on root length (Table 3).

Table 3: Root length (cm) under different growth conditions

Temp.(°C)	Humidity (%)			Mean
	40	60	80	
18	29.47	30.07	26.71	28.75 B
22	33.90	37.72	58.02	43.21 A
26	28.23	28.47	43.21	33.30 B
Mean	30.53 B	32.08 B	42.64 A	

Mean in the same column by the same letter are not significantly different to the test of Duncan (p≤0. 05).

Regardless moisture content, average results for temperature were significant for root diameter but no difference between 18 °C and 22 °C. In agreement with root length, the widest diameter was determined under 80 % moisture content (Table 4).

Table 4: Root diameter (mm) under different growth conditions

Temp. (°C)	Humidity (%)			Mean
	40	60	80	
18	1.76	2.12	2.11	2.00 A
22	1.85	2.13	2.26	2.08 A
26	1.30	0.95	1.60	1.29 B
Mean	1.65 B	1.73B	1.99 A	

Mean in the same column by the same letter are not significantly different to the test of Duncan (p≤0. 05).

Table 5: Root number per cutting

Temp. (°C)	Humidity (%)			Mean
	40	60	80	
18	4.99	4.40	4.80	4.72 B
22	6.37	5.57	7.70	6.54 A
26	4.87	7.27	4.33	5.49 AB
Mean	5.41	5.74	5.61	

Mean in the same column by the same letter are not significantly different to the test of Duncan (p≤0. 05).

Average results related with temperature were significant for root number per cutting for each applications but soil moisture content did not elicit any significant changes.

In cutting propagation, no direct relationship with the rooting and callus formation, which occurs as a response to injury but increase the survival time of cuttings by preventing the decay in rooting medium has been reported (Kaşka and Yılmaz, 1990; Koyuncu et al., 2003a). However, in the present study, there was a parallel variation between callus formation and rooting percentage. These results are agreement with the report by Yıldız and Koyuncu (2000) but disagree with the studies (Sezgin 2009, Koyuncu et al., 2003a). In addition to delaying the decay of cuttings through formation of a protective layer, callus tissue was reported to help the water intake in some cases (Hartman and Kester, 1974). Herein, the highest callus formation percentage was found less than 22°C but no difference was determined between 18°C and 22°C. An increase up to 26°C slowed down callus formation. In general, keeping temperature in rooting media around 24°C promote cell division and callus formation (Ağaoğlu et al., 1995) but it is worthy to note that those temperature values might vary according to the different plant species.

Moisture content in rooting media effected callus formation and 40 % of field capacity was the most favourable for callus formation. Up to our best knowledge, there is no study on the relation between moisture content and callus formation but in general, moisture content at a level is required in order to prevent ventilation (Hartman and Kester, 1974). Basal heating of rooting media can enhance root formation percentage (Alexandrow 1988); Yıldız and Koyuncu (2000) recorded an increase from 60 % to 89 %.

Even the highest average of root length was obtained from the rooting media with highest moisture content; there was decay in many cutting samples. This condition is probably caused by obstruction of the ventilation due to the high moisture content. Indeed, a good aeration of the rooting medium, in addition to good moisture retention, is stated to be the best (Hartmann and Kester, 1974).

CONCLUSIONS

In the study, the best root width was obtained under 18°C and 22°C but it decreased by 26°C. An increase in temperature of the rooting media decreased the width of root. Those coincided with the studies by Yıldız et al. (2009) and Sezgin (2009). In this study, moisture content in rooting media did not cause any change in number of root formation. The present results concerned with root formation are in good agreement with the previous studies (Koyuncu et al., 2003b, Yıldız et al., 2009; Sezgin, 2009, Erdoğan and Aygün, 2006).

REFERENCES

Ağaoğlu Y.S., Çelik H., Çelik M., FidanY., GülşenY., Günay A., Halloran N., Köksal A.İ., Yanmaz R., 1995. Genel Bahçe Bitkileri. Ankara Üniversitesi Ziraat Fakültesi Eğitim,Araştırma ve Geliştirme Vakfı Yayınları, No:4.

Alexandrov A., 1988. İnvestigations of the Rooting Process in Ripe Mulberry Cutting Taken From Various Parts of Overwintered Shoots Plant Science 35(9), 86-93.

Chen P.N, Chu H.L, Kuo W.H, Chiong C.L, Hsief Y.S., 2005. Mulberry Anthocyanins, Cyanidin-3-rutinoside and Cyanidin-3- glucoside, Exhibited and Inhibitory Effect on The Migration and of a Human Long Cancer Cell Line. Cancer Letters 1–12.

Datta R.K., 2002. Mulberry Cultivation and Utilization in India. Mulberry for Animal Production, FAO Animal Production and Healt Paper 147: 45-62.

Davis P.H., 1972. Flora of Turkey IV. Edinburg Uni. Press. Edinburg, 657 p. De Candolle, A., 1967. Origin of Cultivated Plants. New York and London. P. 149- 153.

Erdoğan V., Aygün, A., 2006. Karadutun (Morus nigra L.) yeşil çelikle çoğaltılması üzerine bir araştırma. II. Ulusal Üzümsü Meyveler Sempozyumu 172-175 (14 16 Eylül 2006).

Hartman H.T, Kester, D.E., 1974 Bahçe Bitkileri Yetiştirme Tekniği. (Çevirenler: N. Kaşka ve M. Yılmaz) Ç.Ü.Z.F. Ders kitabı no: 79 Adana.

Kaşka N. ve Yılmaz M., 1990 Bahçe Bitkileri Yetiştirme Tekniği. Çuk. Üniv. Zir. Fak. No: 52 Adana.

Koyuncu F, Vural E. Çelik M., 2003b. Karadut (Morus nigra L.) Çeliklerinin Köklendirilmesi Üzerine Araştırmalar. Ulusal Kivi ve Üzümsü Meyveler Sempozyumu Kitabı, s: 424-427, Ordu.

Koyuncu F. Şenel E., 2003a. Rooting of Black Mulberry (Morus nigra L.) Hardwood Cuttings. J. Fruit Ornam. Plant Res., 11: 53-57.

Özbek S., 1977. Genel Meyvecilik. Çukurova Üniv. Ziraat Fak. Yay.111, Ders Kitapları:6, Adana. 386.

Özgen M., Serçe S. Kaya C., 2009. Phytochemical and Antioxidant Properties of Anthocyanin-rich Morus nigra and Morus rubra fruits. Scientia Horticulturae 119: 275–279.

Prior R.L., 2003. Absorption and Metabolism of Anthocyanins: Potential Health Effects. In: Phytochemicals: Mechanisms of Action. CRC Press Inc., Boca Raton, FL.

Sezgin O., 2009. Genotipik farklılığın karadut odun çeliklerinin köklenmesi üzerine etkisi. Yüksek Lisans Tezi, GOÜ, Fen Bilimleri Enstitüsü.

Yıldız K., Koyuncu F, 2000. Karadutun (M. nigra L.) Odun Çelikleri ile Çoğaltılması Üzerine Bir Araştırma. Derim, 17(3): 130-135.

Yıldız K., Çetin Ç., Güneş M., Özgen M., Özkan Y., Akça Y., Gerçekçioğlu R, 2009. Farklı Dönemlerde Alınan Kara Dut (Morus nigra L.) Çelik Tiplerinde Köklenme Başarısının Belirlenmesi. GOÜ Ziraat Fakültesi Dergisi, 26(1), 1-5.

Zarfa -Stone S., Yasmin T., Bagchi M., Chatterjee A., Vinson J.A., Bagchi D., 2007. Berry Anthocyanins as Novel Antioxidants in Human Health and Disease Prevention. Mol. Nutr. Food Res. 51, 675–683.

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